HIGH-RESOLUTION SENSING METHOD FOR SCANNER

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The invention relates in general to a sensing method of a scanner, and more particularly, to a high-resolution sensing method for a scanner.

Description of the Related Art

[0002] A scanner scans a document by incorporating a charge coupled device that detects the light intensity reflected from the document. The charge coupled device may perform a gray-scale scan or a color scan by using a whole row of sensors to scan the light intensity reflected from the document. Figure 1 shows a schematic drawing of a conventional scanner.

[0003] In Figure 1, a step motor 102 moves a chassis 108 to an optical resolution distance (that is, the width of one row of sensors in the charge coupled device 104). The light emitted from the lamp 106 projects on the document 110, and is then reflected thereby and travels through a mirror 112, a lens 114 to the sensors 116, 118, 120 (R, G, B sensors) in the charge coupled device 104. The detected image signal is then sent to a subsequent circuit (not shown) for signal processing. The step motor 102 then shifts the chassis with an optical resolution distance along the scan direction. According to the above steps, the image signal detected from the next row of the document 110 is sent to the subsequent circuit for signal processing by the charge coupled device 104. Thereby, the image data for the whole document 110 can be obtained.

[0004] While scanning the document 110, the optical resolution of the step motor 102, that is, the distance that the chassis 108 is moved by the step motor 102 each time, is reduced to enhance the scan resolution. For example, the motor moves one step in 10ms with a rotating speed of 100pps for one time of the optical resolution. If 16 times of the optical resolutions is required, the step motor 102 moves 16 steps in 10 ms with a rotating speed of 1600pps. Therefore, the higher the resolution of the scanner 100 is, the more the speed of the step motor 102 varies. It is difficult to design a step motor with a large speed variation. The cost thereof is greatly increased.

SUMMARY OF THE INVENTION

[0005] The present invention provides a high-resolution sensing method for a scanner that increases the rows of the sensors to obtain the high-resolution function without changing, or greatly increasing speed variation of the step motor. The design difficulty is thus resolved, while the fabrication cost is not greatly increased.

[0006] In the high-resolution sensing method for a scanner provided by the present invention, the scanner has m times of resolutions. The scanner has a motor and a charge coupled device. The charge coupled device further has m rows of spaced sensors. Each of the m rows of sensors is spaced a distance from the other. The motor moves a distance equal to the width of one row of sensors with a moving speed equal to the width of one row of sensor divided by an exposure time. During the exposure time, staggered rows of the sensors are scanned to obtain the image signals.

[0007] The present invention further provides a high-resolution sensing method to allow a scanner to have m+1 times of resolution. The scanner has a motor and a charge coupled device. The charge coupled device further has m rows of sensors

spaced a distance from each other. The high-resolution sensing method for the scanner includes moving the motor a distance m/(m+1) times the width of one row of the sensors, while the moving speed of the motor is equal to m/(m+1) the width of one row of the sensors divided by an exposure time. During the exposure time, alternate rows of the sensors are scanned to obtain an image signal. Thereby, a high-resolution function of the scanner is obtained without increasing the moving speed of the motor.

[0008] Both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention, as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Figure 1 shows a schematic drawing of a conventional scanner;

[0010] Figure 2 is a schematic drawing showing a scanner in one embodiment of the present invention;

[0011] Figure 3 shows a method of doubling the resolution according to the present invention;

[0012] Figure 4 shows a method of tripling the resolution according to the present invention;

[0013] Figure 5 shows another method of tripling the resolution according to the present invention; and

[0014] Figure 6 shows another method tripling the resolution according to the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0015] Referring to Figure 2, a schematic drawing of a scanner provided in the present invention is shown. In Figure 2, the step motor 202 moves the chassis 208 an optical resolution distance (that is, the width of one row of sensors of the charge coupled device 204). The lamp 206 projects a light on the document 210. The light incident on the document 210 is reflected through the mirror 212 and the lens 214 to reach the sensors 216, 218 and 220 of the charge coupled device 204. The sensors 216, 218 and 220 include rows of sensors to detect three primary colors R, G, B. The charge coupled device 204 sends the detected image signal to the subsequent circuit (not shown) for signal processing. The step motor 202 then moves the chassis 208 an optical resolution distance along the scan direction. Accordingly, a next image signal corresponding to a next row of the document 210 is sent to the subsequent circuit for signal processing by the charge coupled device 204. Thereby, the image data for the whole document 210 can be scanned and obtained by the scanner 200.

[0016] Figure 3 shows a method of obtaining twice the resolution. In Figure 3 (also referring to Figure 2), the step motor 202 moves along the scan direction with a speed of one optical resolution (that is, the moving speed of the step motor 202 $V=D/T$, where D is the width of one row of sensors and T is the exposure time). The scanner scans the document 210 with double the resolution. Block A indicates the A row of sensors 302, block B indicates the B row of sensors 304, where the B row of sensors 302 and A row of sensors 304 are spaced from each other by a distance ΔL equal to $\frac{1}{2}D$, or alternatively equal to $\frac{1}{2}D+nD$, n is an integer equal to or larger than zero. Again, D is the width of one row of the sensors.

[0017] At T=t, the step motor 202 moves along the scan direction the width of

one row of the sensors, the A row of sensors 302 scans the first and second regions of the document 210 (the width of scanned two regions of the document 210 is equal to the width of one row of sensors) to obtain an image signal of row A1.

[0018] At T=2t, the step motor 202 moves further along the scan direction the width of one row of the sensors, the A row of sensors 302 scans the third and fourth regions of the document 210 to obtain an image signal of row A2.

[0019] At T=3t, the step motor 202 moves along the scan direction the width of one row of the sensors, the A row of sensors 302 scans the fifth and sixth regions of the document 210 (the width of two scanned regions of the document 210 is equal to the width of one row of sensors) to obtain an image signal of row A3. Meanwhile, the B row of sensors 304, spaced a half width of one row of the sensors (equivalent to the width of one scanned region) from the A row of sensors 302, scans the second and the third regions of the document to obtain the image signal of the row B3.

[0020] At T=4t, the step motor 202 moves along the scan direction the width of one row of the sensors, and the A row of sensors 302 scans the seventh and eighth regions of the document 210 (the width of two scanned regions of the document 210 is equal to the width of one row of sensors) to obtain an image signal of row A4. Meanwhile, the B row of sensors 304, spaced a half width of one row of the sensors from the A row of sensors 302, scans the fourth and the fifth regions of the document to obtain the image signal of the row B4.

[0021] Accordingly, when the step motor 202 moves with the speed of one optical resolution to scan the document 210, image signals scanned by the A row of sensors 302 and the B row of sensors 304 are obtained from regions spaced a distance equal to one-half the width of one row of the sensors from each other. For example,

the image signal of row A1 is obtained by scanning the first and the second regions. The image signal of row B3 is obtained by scanning the second and the third regions, and the image signal of row A2 is obtained by scanning the third and the fourth regions. The image signals are staggered with each other. The image signal of row B4 is obtained by scanning the fourth and the fifth regions, while the image signal of row A3 is obtained by scanning the fifth and the sixth regions, and so on.

[0022] All the image signals with overlapped scanned regions detected by row A of sensors 302 and row B of sensors 304 are sent to the subsequent circuit for image processing and data sorting and recording, and a complete image data can be obtained. Therefore, by simply doubling the rows of sensors, the resolution of the scanner is doubled without increasing the optical resolution speed of the step motor 202.

[0023] Figure 4 shows a schematic drawing of the method to triple the resolution. In Figure 4 (also referring to Figure 2), the step motor 202 moves along the scan direction with a speed of one optical resolution (that is, the moving speed of the step motor 202 V=D/T, where D is the width of one row of sensors and T is the exposure time). The scanner scans the document 210 with triple resolution. Block A indicates the A row of sensors 402, block B indicates the B row of sensors 404, and block C indicates the C row of sensors 406, where the A row of sensors 402, the B row of sensors 404 and the C row of sensors 406 are spaced from each other by a distance ΔL equal to 2/3D, or alternatively equal to 2/3D+nD, n is an integer equal to and larger than zero. Again, D is the width of one row of the sensors.

[0024] At T=t, the step motor 202 moves along the scan direction the width of one row of the sensors, so that the A row of sensors 402 scans the first, the second and the third regions of the document 210 (the width the three scanned regions of the

document 210 is equal to the width of one row of sensors) to obtain an image signal of row A1.

[0025] At T=2t, the step motor 202 moves further along the scan direction the width of one row of the sensors, the A row of sensors 402 scans the fourth, the fifth, and sixth regions of the document 210 to obtain an image signal of row A2.

[0026] At T=3t, the step motor 202 moves the width of one row of the sensors along the scan direction, and the A row of sensors 402 scans the seventh, eighth and ninth regions of the document 210 (the width of the scanned three regions of the document 210 is equal to the width of one row of sensors) to obtain an image signal of row A3. Meanwhile, the B row of sensors 404, spaced two-thirds the width of one row of the sensors (equivalent to the width of two scanned region) from the A row of sensors 402, scans the second, the third and the fourth regions of the document to obtain the image signal of the row B3.

[0027] At T=4t, the step motor 202 moves the width of one row of the sensors along the scan direction, and the A row of sensors 402 scans the tenth, eleventh and twelfth regions of the document 210 (the width of the scanned three regions of the document 210 is equal to the width of one row of sensors) to obtain an image signal of row A4. Meanwhile, the B row of sensors 404, spaced two-thirds the width of one row of the sensors from the A row of sensors 302, scans the fifth, the sixth and the seventh regions of the document to obtain the image signal of the row B4.

[0028] At T=5t, the step motor 202 moves the width of one row of the sensors along the scan direction, and the A row of sensors 402 scans the thirteenth, fourteenth, and fifteenth regions of the document 210 (the width of three scanned regions of the document 210 is equal to the width of one row of sensors) to obtain an image signal of

row A5. Meanwhile, the B row of sensors 404, spaced two-thirds the width of one row of the sensors from the A row of sensors 402, scans the eighth, the ninth and the tenth regions of the document to obtain the image signal of the row B4. The C row of sensors 406, spaced two-thirds the width of one row of the sensors from the B row of sensors 404, also scans the third, the fourth and the fifth regions of the document to obtain the image signal of the row C5.

[0029] Accordingly, when the step motor 202 moves with the speed of one optical resolution to scan the document 210, the A, B and C rows of sensors 402, 404 and 406 scan the regions of the document 210 spaced a distance equal to two-thirds the width of one row of the sensors from each other. The image signals obtained are staggered by one region, for example, the image signal of row A1 from the first, second, third regions, the image signal of row B2 from the second, the third and the fourth regions, and the image signal of row C3 from the third, fourth and the fifth regions.

[0030] All the image signals detected by row A of sensors 402, row B of sensors 404, and the row C of sensors 406 are sent to the subsequent circuit for image processing and data sorting and recording, and a complete image data can be obtained. Therefore, by simply tripling the rows of sensors, the resolution of the scanner is tripled without increasing the optical resolution speed of the step motor 202.

[0031] Figure 5 shows a schematic drawing of another method to triple the resolution. In Figure 5 (also referring to Figure 2), the step motor 202 moves along the scan direction with a speed of one optical resolution (that is, the moving speed of the step motor 202 V=D/T, where D is the width of one row of sensors and T is the exposure time). The scanner scans the document 210 with triple resolution. Block A indicates the A row of sensors 502, block B indicates the B row of sensors 504, and

block C indicates the C row of sensors 506, where the A row of sensors 502, the B row of sensors 504 and the C row of sensors 506 are spaced from each other by a distance ΔL equal to 4/3D, or alternatively equal to 1/3D+nD, n is an integer equal to or larger than zero. Again, D is the width of one row of the sensors.

[0032] At T=t, the step motor 202 moves the width of one row of the sensors along the scan direction, so that the A row of sensors 502 scans the first, the second and the third regions of the document 210 (the width of three scanned regions of the document 210 is equal to the width of one row of sensors) to obtain an image signal of row A1.

[0033] At T=2t, the step motor 202 moves the width of one row of the sensors further along the scan direction, the A row of sensors 502 scans the fourth, the fifth, and sixth regions of the document 210 to obtain an image signal of row A2.

[0034] At T=3t, the step motor 202 moves the width of one row of the sensors along the scan direction, the A row of sensors 502 scans the seventh, eighth and ninth regions of the document 210 (the width of the scanned three regions of the document 210 is equal to the width of one row of sensors) to obtain an image signal of row A3.

[0035] At T=4t, the step motor 202 moves the width of one row of the sensors along the scan direction, the A row of sensors 502 scans the tenth, eleventh and twelfth regions of the document 210 (the width of the three scanned regions of the document 210 is equal to the width of one row of sensors) to obtain an image signal of row A4. Meanwhile, the B row of sensors 504 spaced from the A row of sensors 502 by four-thirds the width of one row of the sensors (equivalent to the width of four scanned regions) scans the third, the fourth and the fifth regions of the document to obtain the image signal of the row B4.

[0036] At T=5t, the step motor 202 moves the width of one row of the sensors along the scan direction, the A row of sensors 502 scans the thirteenth, fourteenth and fifteenth regions of the document 210 to obtain an image signal of row A5. Meanwhile, the B row of sensors 504, spaced four-thirds the width of one row of the sensors from the A row of sensors 502, scans the sixth, the seventh and the eighth regions of the document to obtain the image signal of the row B5.

[0037] At T=6t, the step motor 202 moves the width of one row of the sensors along the scan direction, the A row of sensors 502 scans the sixteenth, seventeenth, and eighteenth regions of the document 210 to obtain an image signal of row A6. Meanwhile, the B row of sensors 504, spaced four-thirds the width of one row of the sensors from the A row of sensors 502, scans the ninth, the tenth and the eleventh regions of the document to obtain the image signal of the row B6. The C row of sensors 506, spaced four-thirds of the width of one row of the sensors from the B row of sensors 504, also scans the second, the third and the fourth regions of the document 210 to obtain the image signal of the row C6.

[0037] Accordingly, when the step motor 202 moves with the speed of one optical resolution to scan the document 210, the A, B and C rows of sensors 502, 504 and 506 scan the regions of the document 210 spaced from each other by a distance equal to four-thirds the width of one row of the sensors. The image signals obtained from the regions are spaced the width of one region from each other. For example, the image signal of row A1 from the first, second, third regions, the image signal of row C6 from the second, the third and the fourth regions, and the image signal of row B4 from the third, fourth and the fifth regions are staggered with each other.

[0038] All the image signals detected by the row A of sensors 502, the row B of

sensors 504, and the row C of sensors 506 are sent to the subsequent circuit for image processing and data sorting and recording, and a complete image data can be obtained. Therefore, by simply tripling the rows of sensors, the resolution of the scanner is tripled without increasing the optical resolution speed of the step motor 202.

[0039] Figure 6 shows a schematic drawing of another method to triple the resolution. In Figure 6 (also referring to Figure 2), the step motor 202 moves along the scan direction with a speed of one optical resolution (that is, the moving speed of the step motor 202 V=(2/3) D/T, where D is the width of one row of sensors and T is the exposure time). The scanner 200 scans the document 210 with triple resolution. Block A indicates the A row of sensors 602, and block B indicates the B row of sensors 604, where the A row of sensors 602 and the B row of sensors 604 are spaced from each other by a distance ΔL equal to 2D, or alternatively equal to 2nD, where n is an integer equal to or larger than zero. Again, D is the width of one row of the sensors.

[0040] At T=t, the step motor 202 moves two-thirds the width of one row of the sensors along the scan direction, so that the A row of sensors 602 scans the first, the second and the third regions of the document 210 (the width the three scanned regions of the document 210 is equal to the width of one row of sensors) to obtain an image signal of row A1.

[0041] At T=2t, the step motor 202 moves two-thirds the width of one row of the sensors further along the scan direction, the A row of sensors 602 scans the third, the fourth and the fifth regions of the document 210 to obtain an image signal of row A2.

[0042] At T=3t, the step motor 202 moves two-thirds the width of one row of the sensors along the scan direction, the A row of sensors 602 scans the fifth, sixth and seventh regions of the document 210 to obtain an image signal of row A3.

[0043] At T=4t, the step motor 202 moves two-thirds the width of one row of the sensors along the scan direction, the A row of sensors 602 scans the seventh, eighth and ninth regions of the document 210 to obtain an image signal of row A4.

[0044] At T=5t, the step motor 202 moves two-thirds the width of one row of the sensors along the scan direction, the A row of sensors 602 scans the ninth, tenth and eleventh regions of the document 210 to obtain an image signal of row A5.

[0045] At T=6t, the step motor 202 moves two-thirds the width of one row of the sensors along the scan direction, the A row of sensors 602 scans the eleventh, twelfth and thirteenth regions of the document 210 to obtain an image signal of row A6. Meanwhile, the B row of sensors 604, spaced the width of two rows of the sensors (equivalent to the width of six scanned regions) from the A row of sensors 602, scans the second, the third and the fourth regions of the document to obtain the image signal of the row B6.

[0046] Accordingly, when the step motor 202 moves with the speed of two-thirds the optical resolution to scan the document 210, the A and B rows of sensors 602, 604 scan the regions of the document 210 spaced from each other by the width of one region. For example, the image signal of row A1 is obtained from the first, second, and third regions, the image signal of row B6 is obtained from the second, the third and the fourth regions, and the image signal of row A2 is obtained from the third, fourth and the fifth regions.

[0047] All the image signals detected by the row A of sensors 602 and the row B of sensors 604are sent to the subsequent circuit for image processing and data sorting and recording, and a complete image data can be obtained. Therefore, by changing the optical resolution speed of the step motor to two-thirds of the original speed and

increasing the number of rows of the sensors from one to two, the resolution of the scanner 200 is tripled.

[0048] Accordingly, one can further increase the resolution of the scanner (more than triple) by increasing the rows of the sensors, or by changing speed of the step motor into m/(m+1) of the original speed, and increasing the rows of sensors to m rows. Consequently, the resolution is m+1 times multiplied.

[0049] Therefore, the present invention increases the resolution of the scanner without increasing the design difficulty of the step motor and raising the cost issue.

[0050] Other embodiments of the invention will appear to those skilled in the art from consideration of the specification and practice of the invention disclosed herein. It is intended that the specification and examples be considered as exemplary only, with a true scope and spirit of the invention being indicated by the following claims.